

Product Information

ISSUE DATE : August 01, 2000

MODEL : LTM150XH-L04

NOTE : This product information is subject to change after 3 months of issuing date.

SAMSUNG ELECTRONICS CO., LTD.

Better Vision through SAMSUNG TFT-LCD



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GENERAL DESCRIPTION

DESCRIPTION

LTM150XH-L04 is a color active matrix TFT (Thin Film Transistor) liquid crystal display that uses amorphous silicon TFT switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of 15.0- inch contains 1,024 x 768 pixels and can display up to 16.2M colors.

FEATURES

- High brightness, High contrast ratio
- Wide viewing angle
- High-speed response
- XGA(1024x768 pixels) resolution
- 8-bit color depth, Display 16.2M colors
- Low power consumption
- 4 CCFTs (Cold Cathode Fluorescent Tube)
- DE Only Mode
- LVDS Interface with 1pixels / clock

APPLICATIONS

- Desktop monitors
- Display terminals for AV application products
- Monitors for Industrial machine

GENERAL SPECIFICATIONS

ITEM	SPECIFICATION	UNIT	NOTE
Active area	304.1(H) x228.1(V) (15.0 inch diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16,194,277		
Number of pixel	1024 x 768	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.297(H) x 0.297(W)	mm	
Display Mode	Normally white		
Surface treatment	Haze 13 , Anti-glare & Hard - Coating (3H)		

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Mechanical Information

ITEM		MIN.	TYP.	MAX.	NOTE
Module size	Horizontal (H)	-	331.6	-	mm
	Vertical (V)	-	254.9	-	mm
	Depth (D)	-	12.5	13.0	mm
Weight		-	-	1350	g

1. ELECTRICAL ABSOLUTE RATINGS

1.1 TFT LCD MODULE

(V_{ss} = GND = 0 V)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	V _{DD}	V _{ss} -0.3	4.0	V	(1)

NOTE (1) Within Ta (25 ± 2 °C)

1.2 BACK-LIGHT UNIT

Ta = 25 ± 2 °C

ITEM	SYMBOL	MIN.	MAX.	UNIT.	NOTE
Lamp current	I _L	3.0	6.5	mA _{rms}	(1)
Lamp frequency	f _L	40	80	kHz	(1)

NOTE (1) Permanent damage to the device may occur if maximum values are exceeded.
Functional operation should be restricted to the conditions described under Normal Operating Conditions.

2. OPTICAL CHARACTERISTICS

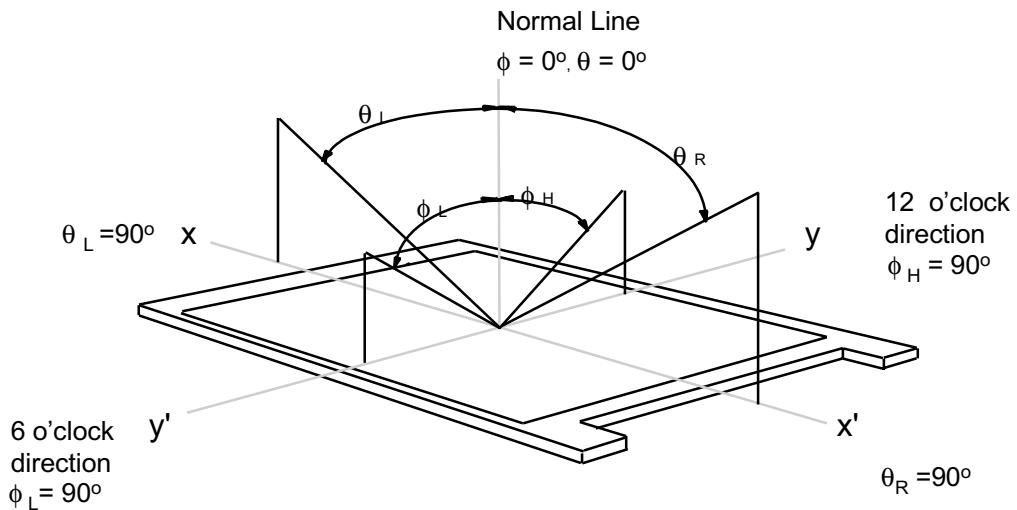
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (4).

Measuring equipment : TOPCON BM-5A

* $T_a = 25 \pm 2 {}^\circ C$, $V_{DD} = 3.3V$, $f_v = 60Hz$, $f_{DCLK} = 65MHz$, $IL = 4.5$ mArms

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE
Contrast Ratio	CR	$\phi = 0$, $\theta = 0$ Normal Viewing Angle	200	350	-		(1),(2),(4)
Response Time at T_a	Rising	T_R	-	5	-	msec	(1), (3)
	Falling		-	20	-		
Luminance of White	Y_L		-	450	-	cd/m ²	(1),(4)
Color Chromaticity (CIE 1931)	Red	R_x	-	TBD	-		(1), (4)
		R_y	-	TBD	-		
	Green	G_x	-	TBD	-		
		G_y	-	TBD	-		
	Blue	B_x	-	TBD	-		
		B_y	-	TBD	-		
	White	W_x	-	(0.298)	-		
		W_y	-	(0.322)	-		
Viewing Angle	Hor.	θ_L	$CR \geq 5$	85			Degrees
		θ_R		85			
	Ver.	ϕ_H		85	-	Degrees	
		ϕ_L		85			
Brightness Uniformity	B_{UNI}		-	-	20	%	(5)

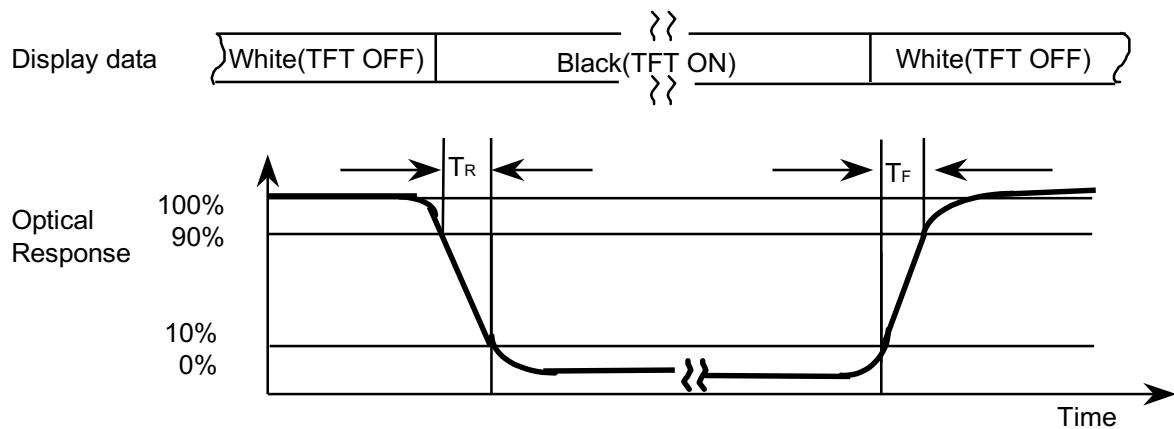
Note 1) Definition of Viewing Angle : Viewing angle range ($5 \leq CR$)



Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at the center point of panel.

$$CR = \frac{\text{Luminance with all pixels white (Gmax)}}{\text{Luminance with all pixels black (Gmin)}}$$

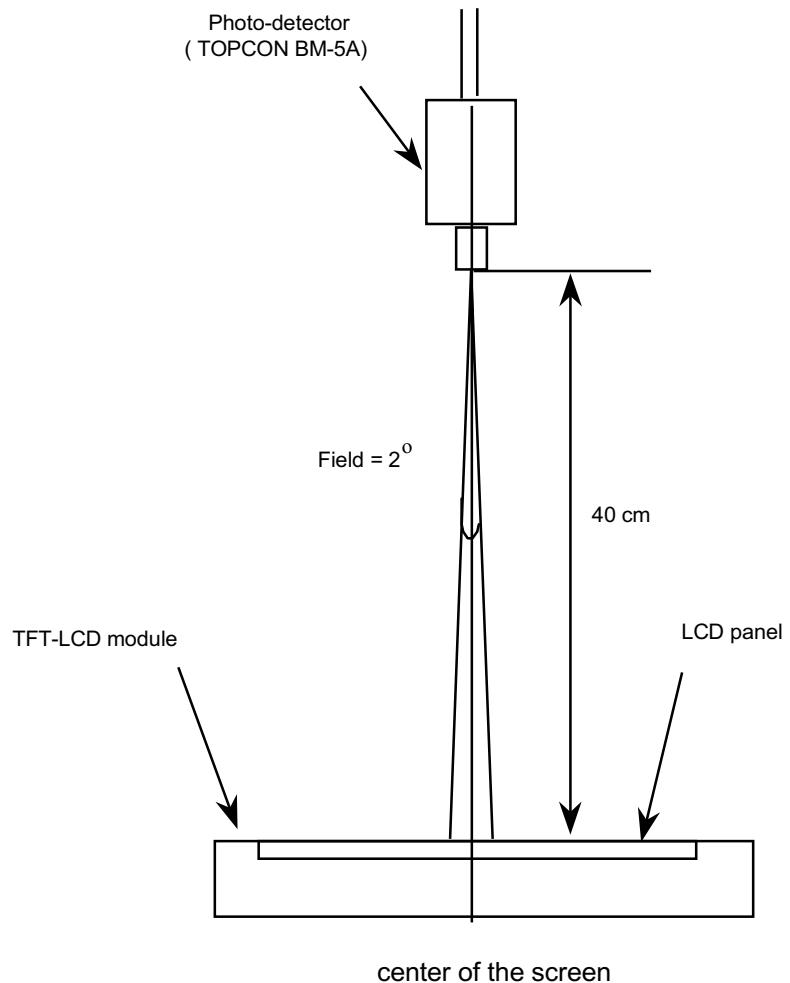
Note 3) Definition of Response time :



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Note 4) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.
lamp current : 4.5mA
Environment condition : $T_a = 25 \pm 2 ^\circ C$



Optical characteristics measurement setup

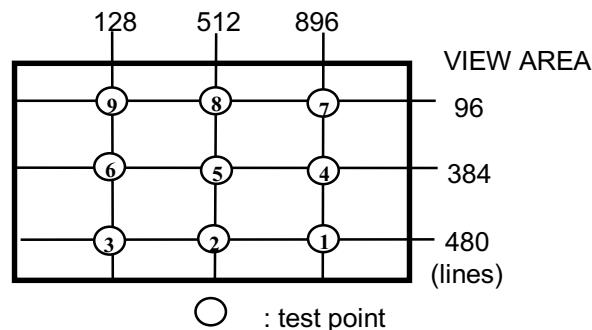
Note 5) Definition of 9 points brightness uniformity

$$B_{UNI} = \frac{| B_{max} \text{ or } B_{min} - B_{ave} |}{B_{ave}} \times 100$$

Bmax : Maximum Brightness

Bmin : Minimum Brightness

$$B_{ave} : \text{Average Brightness} = \frac{\sum_{k=1}^9 (B(k))}{9}$$



3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

T_a = 25 ± 2 °C

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Voltage of Power Supply		V _{DD}	3.0	3.3	3.6	V	
Differential Input Threshold Voltage	High	V _{IH}	-	-	100	mV	(1)
	Low	V _{IL}	100	-	-	mV	
Current of Power Supply		I _{DD}	-	380	-	mA	(2)(4)*a
			-	420	-	mA	(2)(4)*b
			-	470	(550)	mA	(2)(4)*c
Vsync Frequency		f _V	-	60	75	Hz	
Hsync Frequency		f _H	-	48.36	60.0	kHz	
Main Frequency		f _{DCLK}	-	65	80	MHz	(3)
Rush Current		I _{rush}	-	-	1.5	A	(5)

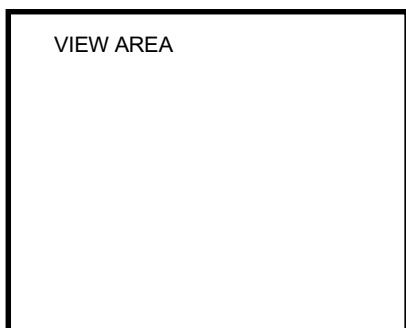
Note (1) Condition : V_{CM} = +1.2V (Typical)

(2) f_V=60Hz, f_{DCLK}=65MHZ, V_{DD} = 3.3V, DC Current.

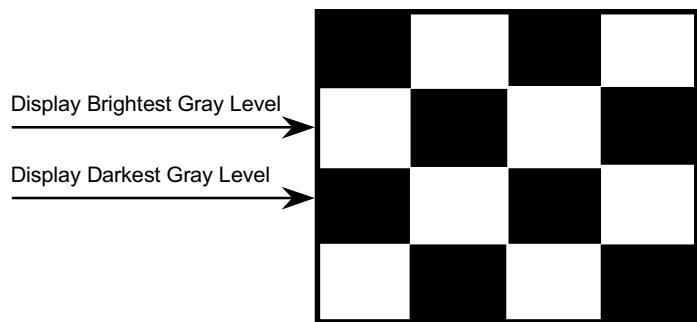
(3) 1 Pixels/clock

(4) Power dissipation check pattern

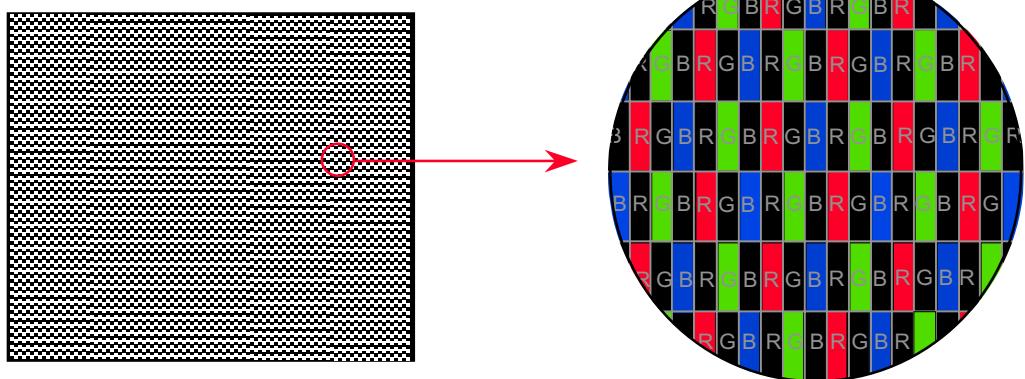
*a) White Pattern



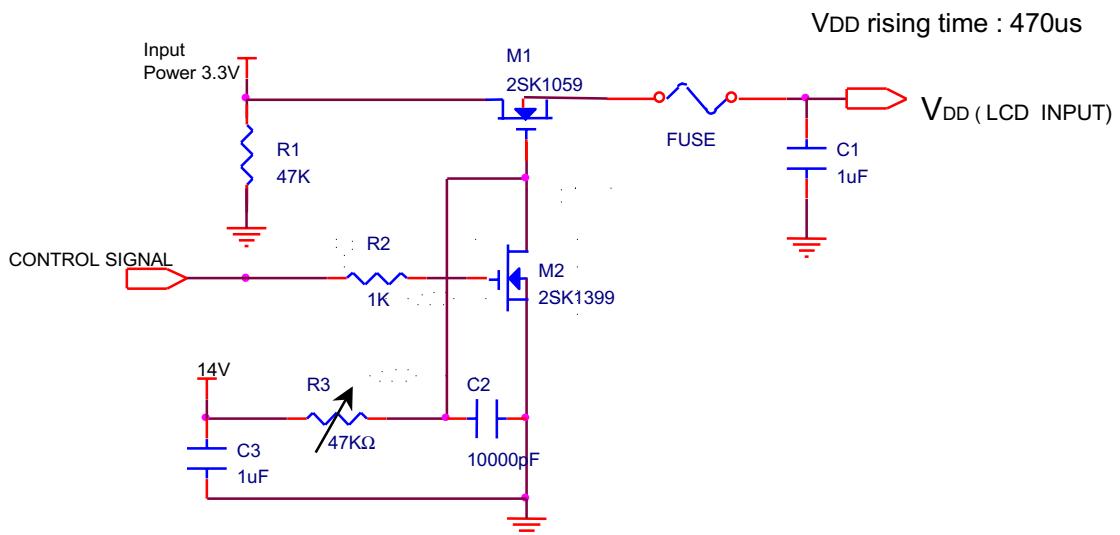
*b) Mosaic Pattern



c) Sub-pixel Checker Pattern



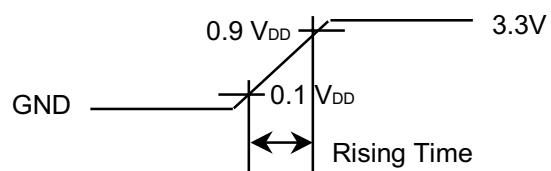
(4) Measurement Conditions



Note : Control Signal : High(+3.3V) -->Low(Ground)

All Signal lines to panel except for power 3.3V : Ground

The rising time of supplied voltage is controlled to 470us by R3 and C2 value.



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3.2 BACK-LIGHT UNIT

The back-light system is an edge-lighting type with 4 CCFTs(Cold Cathode Fluorescent Tube).

The characteristics of four lamps are shown in the following tables.

$T_a = 25 \pm 2 {}^\circ C$

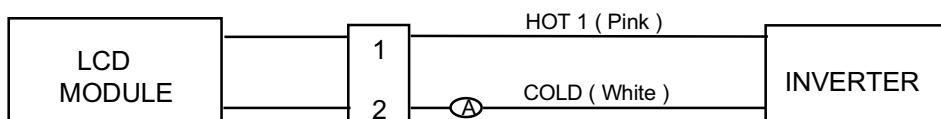
ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I_L	3.0	4.5	6.5	mA_{rms}	(1)
Lamp Voltage	V_L	-	720	-	V_{rms}	$I_L = 6.0$ $mArms$
Lamp Frequency	F_L	40	-	60	kHz	(2)
Operating Life Time	H_r		50,000	-		(3)
Startup Voltage	V_s	-	-	1020 ($25 {}^\circ C$)	V_{rms}	(4)
				1430 ($0 {}^\circ C$)		

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the back-light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back-light and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

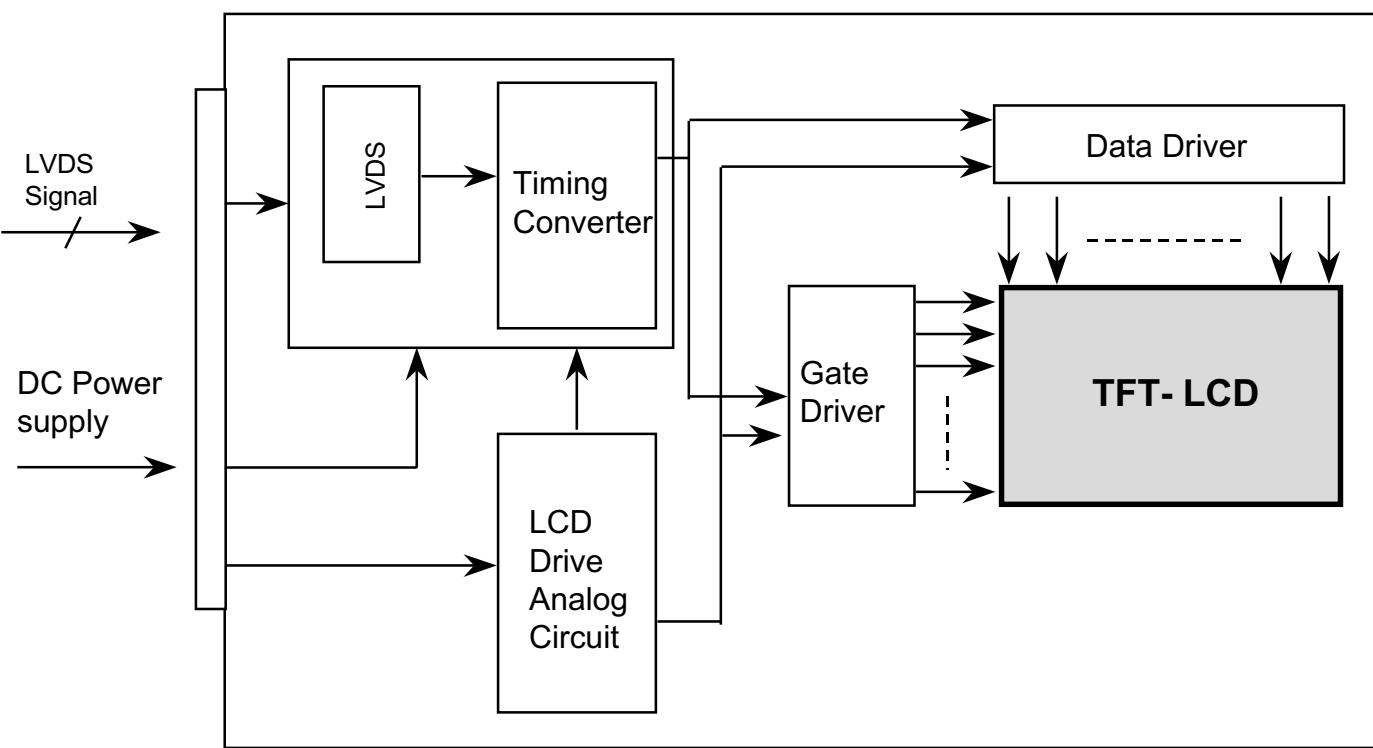
Note (1) Lamp current is measured with current meter for high frequency as shown below.



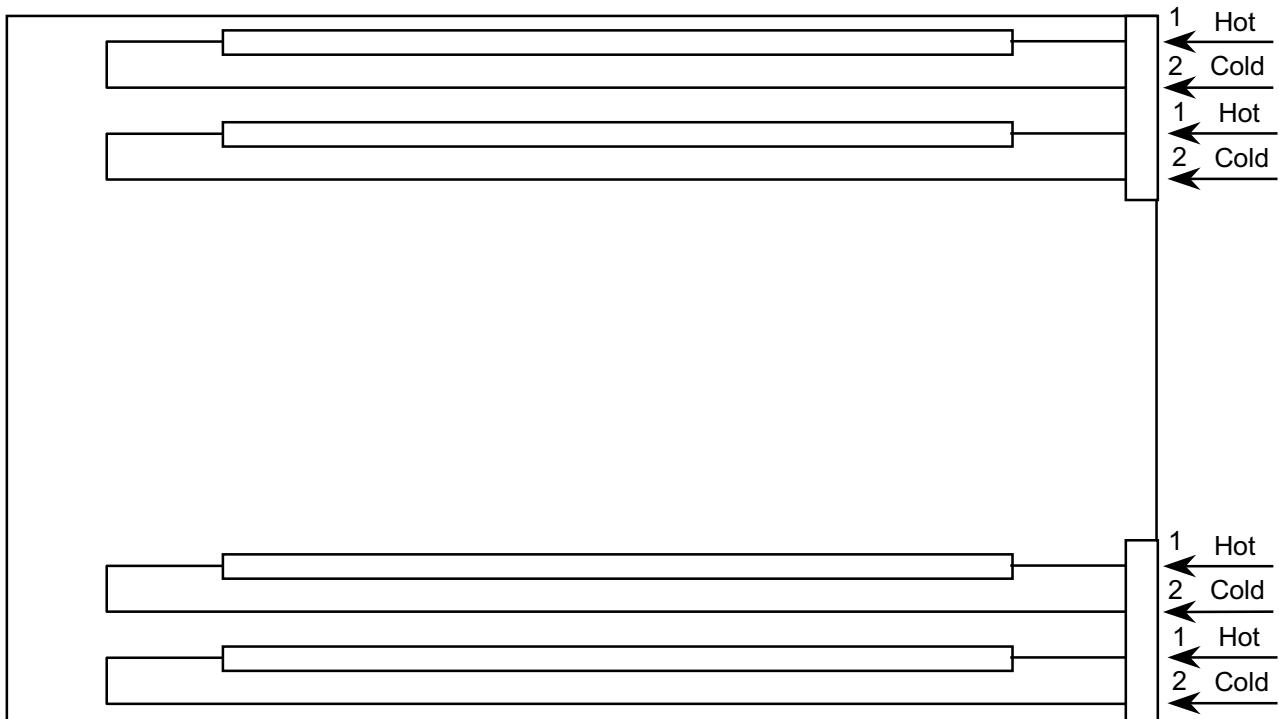
- (2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency shall be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.
- (3) Life time (H_r) of a lamp is defined as the time in which it continues to operate under the condition of $T_a = 25 \pm 2 {}^\circ C$ and $I_L = 4.5 mArms$ until the brightness becomes 50% or lower than its original value.
- (4) The voltage above this value should be applied to the lamps for more than 1 second to startup. Otherwise the lamps may not be turned on.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACK-LIGHT UNIT



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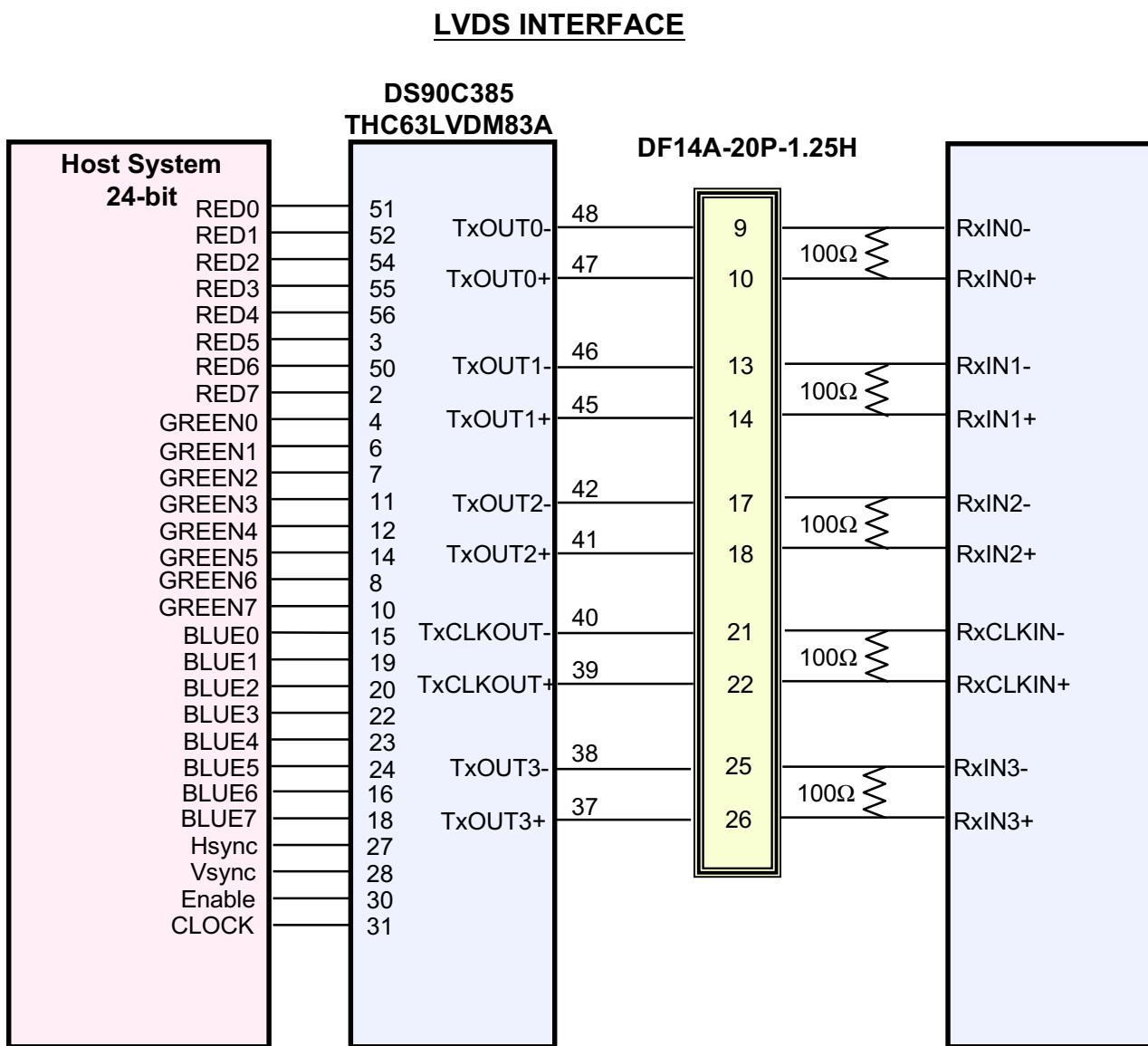


5. INPUT TERMINAL PIN ASSIGNMENT

5.1 Input Signal & Power (LVDS, Connector : Hirose DF14H-20P-1.25H)
Matching Socket : Hirose DF14-20S-1.25C

PIN NO	SYMBOL	FUNCTION	POLARITY	Output Pin# (LVDS Tx)
1	VDD	Power Supply +3.3 V		
2	VDD	Power Supply +3.3 V		
3	GND	Power Ground		
4	GND	Power Ground		
5	RXIN0 -	LVDS Receiver Signal(-)	Negative	PIN#48
6	RXIN0 +	LVDS Receiver Signal(+)	Positive	PIN#47
7	GND	Ground	-	
8	RXIN1 -	LVDS Receiver Signal(-)	Negative	PIN#46
9	RXIN1 +	LVDS Receiver Signal(+)	Positive	PIN#45
10	GND	Ground	-	
11	RXIN2 -	LVDS Receiver Signal(-)	Negative	PIN#42
12	RXIN2 +	LVDS Receiver Signal(+)	Positive	PIN#41
13	GND	Ground	-	
14	RXCLK IN -	LVDS Receiver Clock Signal(-)	Negative	PIN#40
15	RXCLK IN+	LVDS Receiver Clock Signal(+)	Positive	PIN#39
16	GND	Ground	-	
17	RXIN3 -	LVDS Receiver Signal(-)	Negative	PIN#38
18	RXIN3 +	LVDS Receiver Signal(+)	Positive	PIN#37
19	GND	Ground	-	
20	NC	Reserved	-	

5.2 LVDSS Interface



Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

5.3 BACK-LIGHT UNIT

Connector : JST BHSR - 02VS -1
 Mating Connector : SM02B-BHSS-1(JST)

Pin NO.	Symbol	Color	Function
1	HOT	Pink	High Voltage
2	COLD	White	Ground

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5.4 Input Signal, Basic Display Colors and Gray Scale of Each Colors

Color	Display	Data Signal																								Gray Scale Level	
		Red								Green								Blue									
		R 0	R 1	R 2	R 3	R 4	R 5	R 6	R 7	G 0	G 1	G 2	G 3	G 4	G 5	G 6	G 7	B 0	B 1	B 2	B 3	B 4	B 5	B 6	B 7		
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-	
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-	
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Gray Scale of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R000
	Dark	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R001
	↑	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R002
	↓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	R003	
	Light	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252	
	Red	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252	
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252	
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G000	
Gray Scale of Green	Dark	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G001
	↑	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G002
	↓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	G003	
	Light	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252	
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252	
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252	
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B000	
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B001	
Gray Scale of Blue	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B002
	↓	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	0	1	0	0	0	0	0	B003
	Light	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B252	
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	B252
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B252

Note) ✓ Definition of Gray :

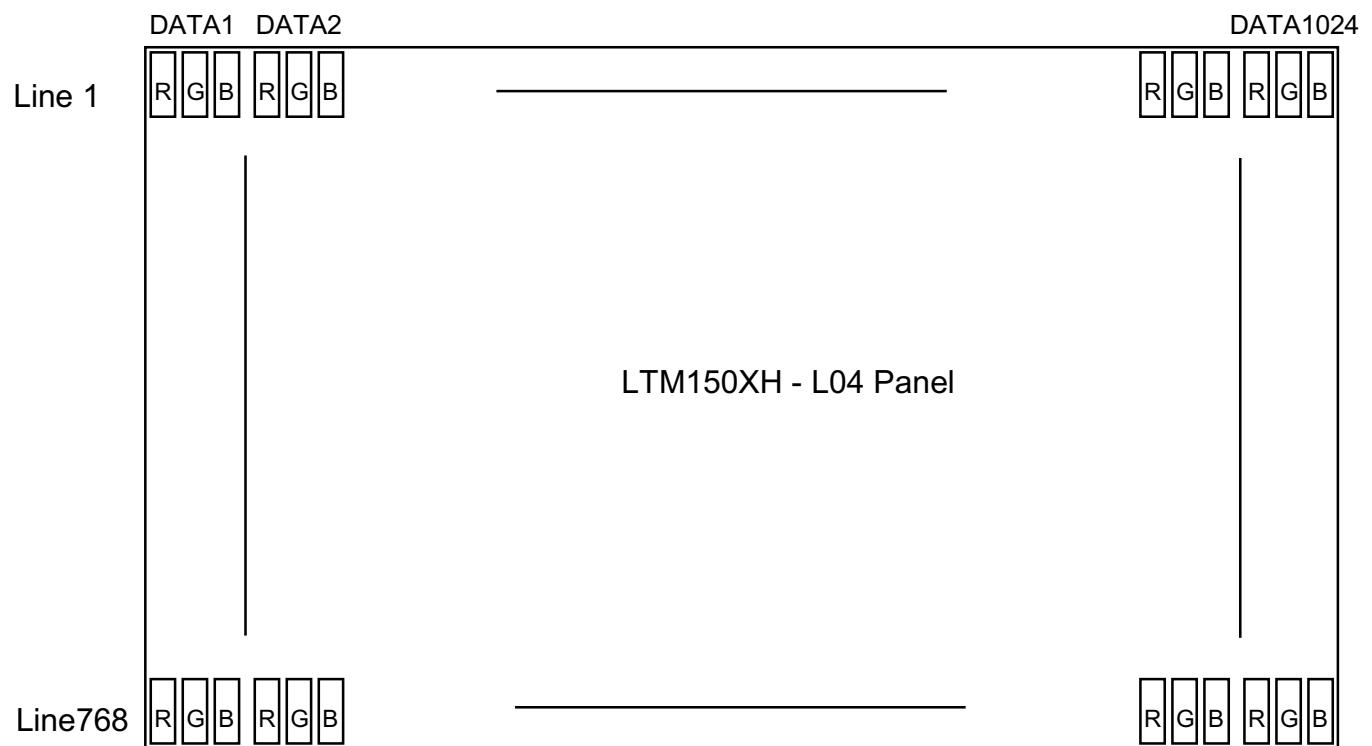
Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

✓ Input Signal : 0 = Low level voltage, 1 = High level voltage

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5.5 PIXEL FORMAT



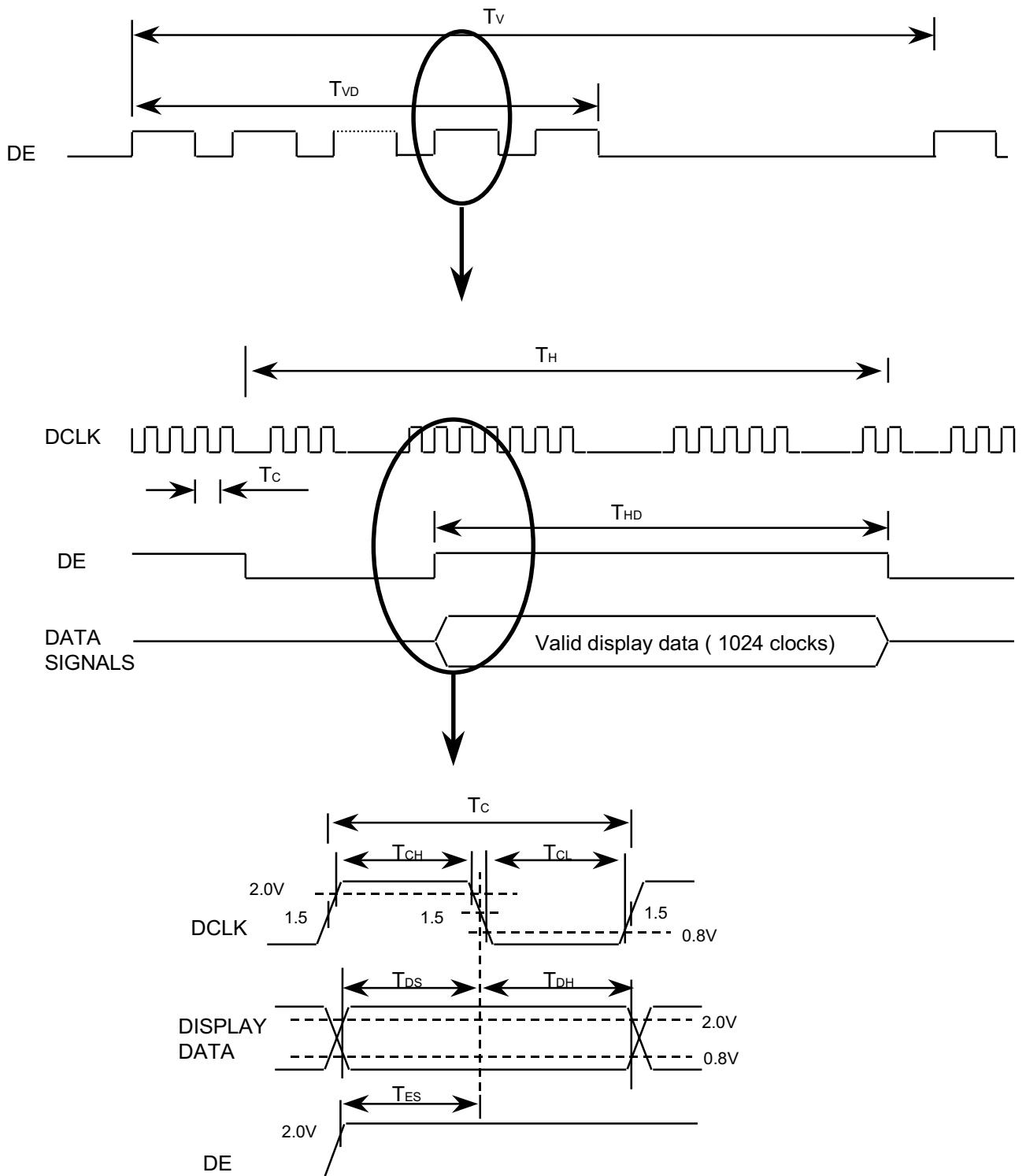
6. INTERFACE TIMING

6.1 Timing Parameters (DE only mode, LVDS Transmitter Input)

Signal	Item	Symbol	MIN	TYP		MAX	Unit	Note
Clock	Frequency	1 / Tc	-	65		80	MHz	
	High Time	T _{CH}	4.5	-		-	nsec	
	Low Time	T _{CL}	4.5	-		-	nsec	
Data	Setup Time	T _{DS}	2.7	-		-	nsec	
	Hold Time	T _{DH}	0	-		-	nsec	
Data Enable	Setup Time	T _{ES}	2.7	-		-	nsec	(1)
Frame Frequency	Cycle	T _V	772	16.7	806	-	msec	lines
Vertical Active Display Term	Display Period	T _{VD}	768	768		768	lines	
One Line Scanning Time	Cycle	T _H	1100	1344	(1800)		clocks	
Horizontal Active Display Term	Display Period	T _{HD}	1024	1024	1024		clocks	

Note (1) When LTM150XH-L04 model is operated by DE only mode, Hsync and Vsync input signals should be fixed to "Low" for stable operation. Otherwise, the module could operate abnormally.

6.2 Timing diagrams of interface signal (DE mode)

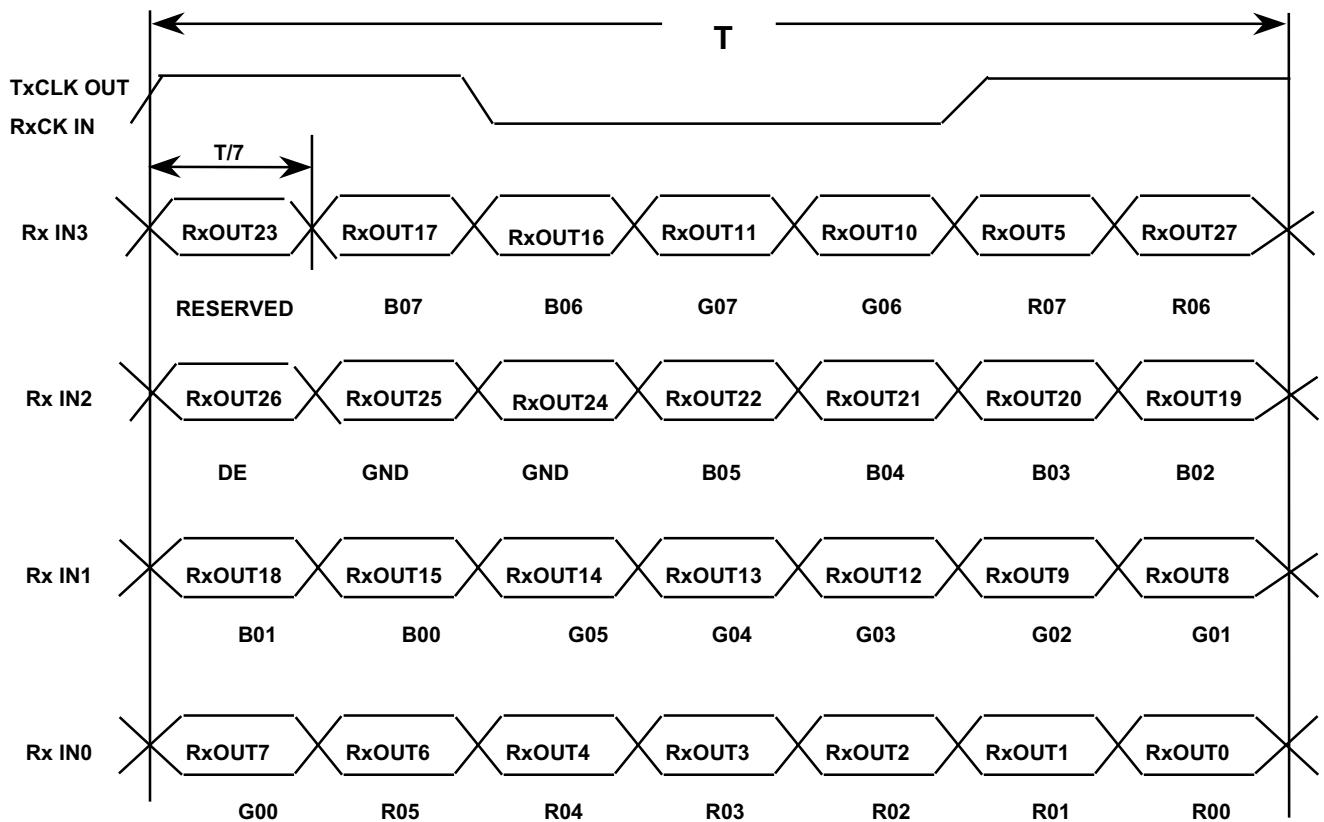


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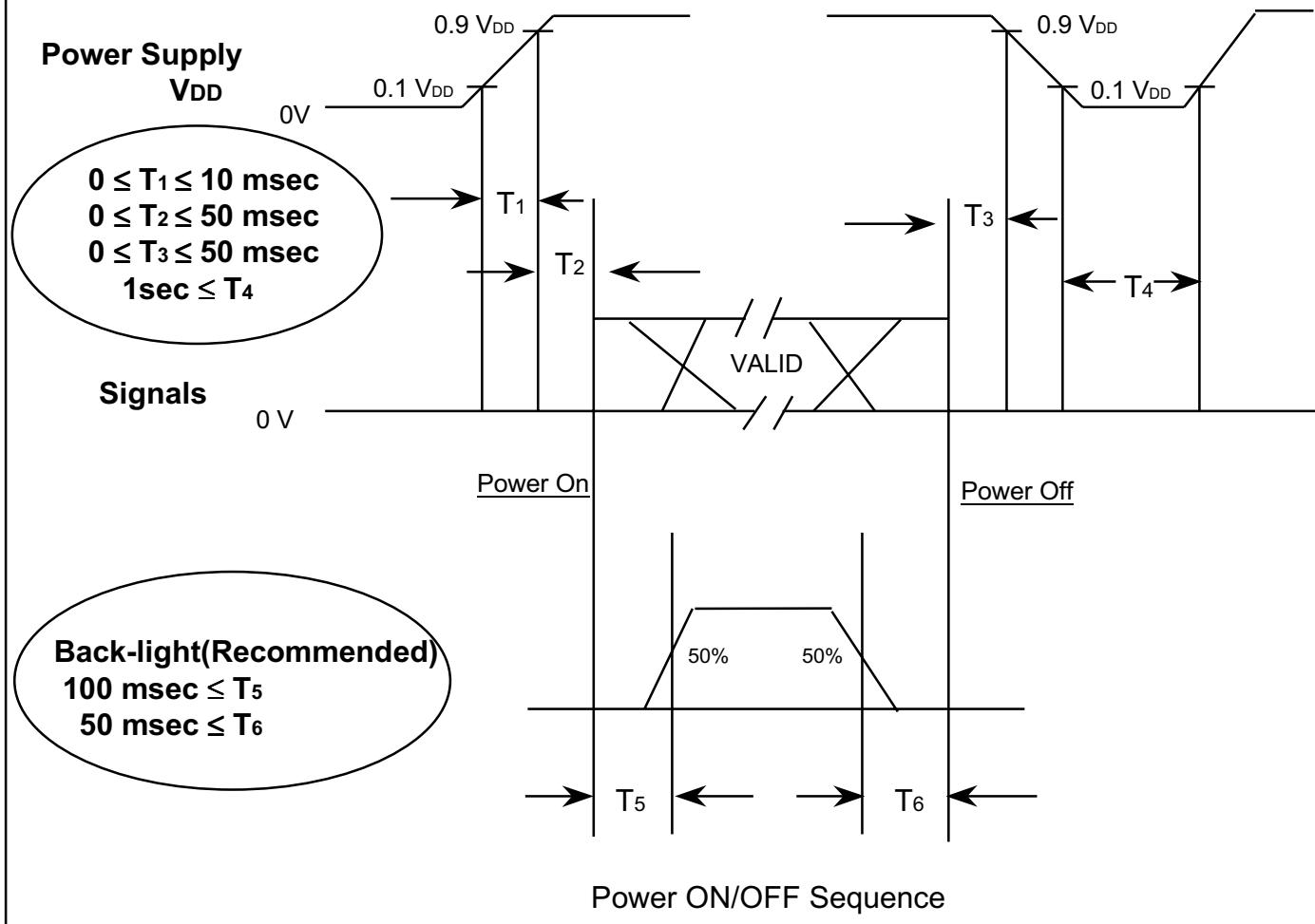
6.3 Timing Diagrams of LVDS

LVDS Transmitter : National Semiconductor DS90CF385



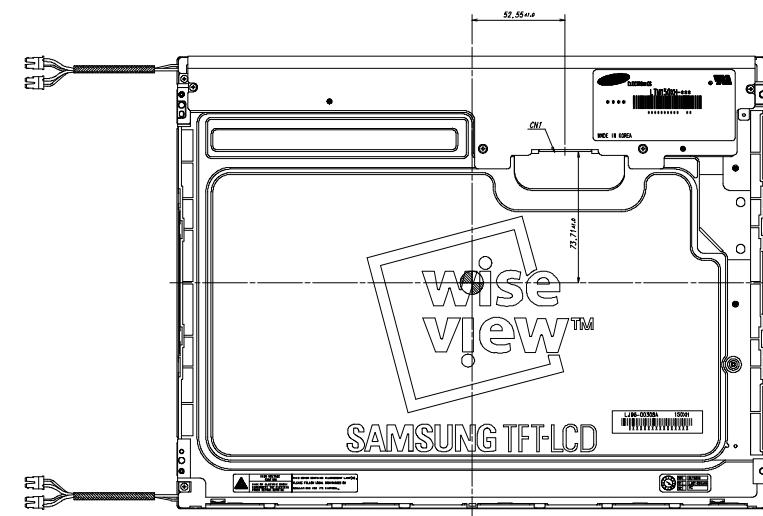
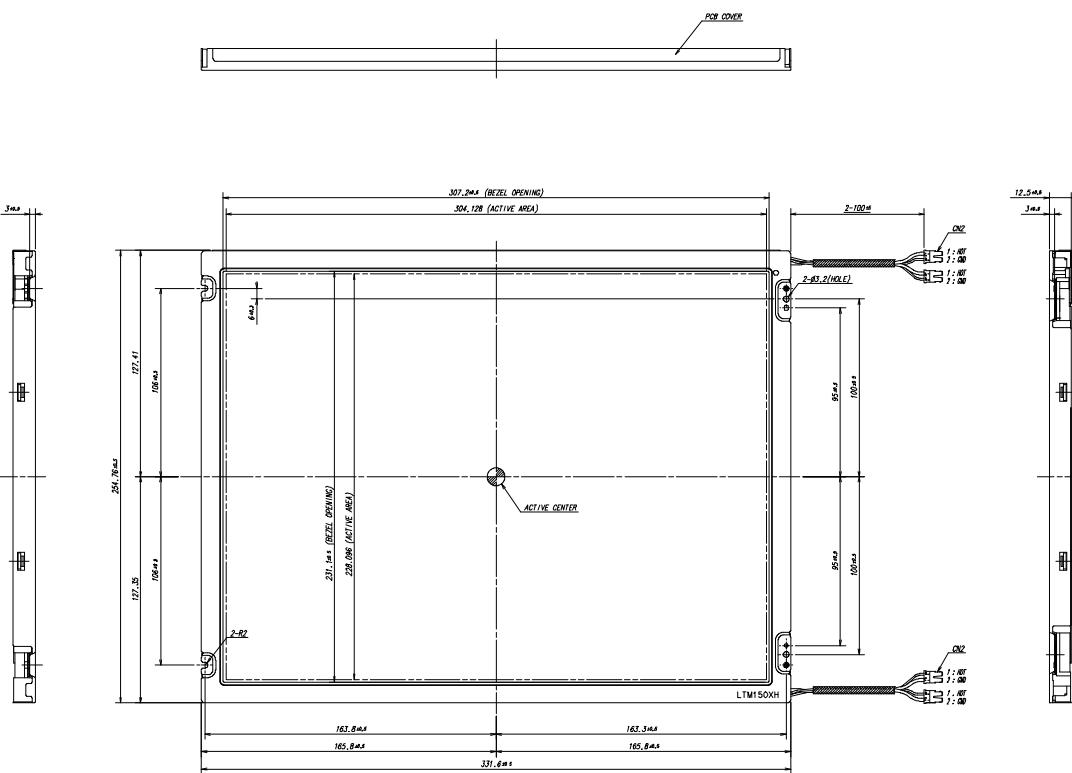
6.4 Power ON/OFF Sequence

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.
- (3) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.



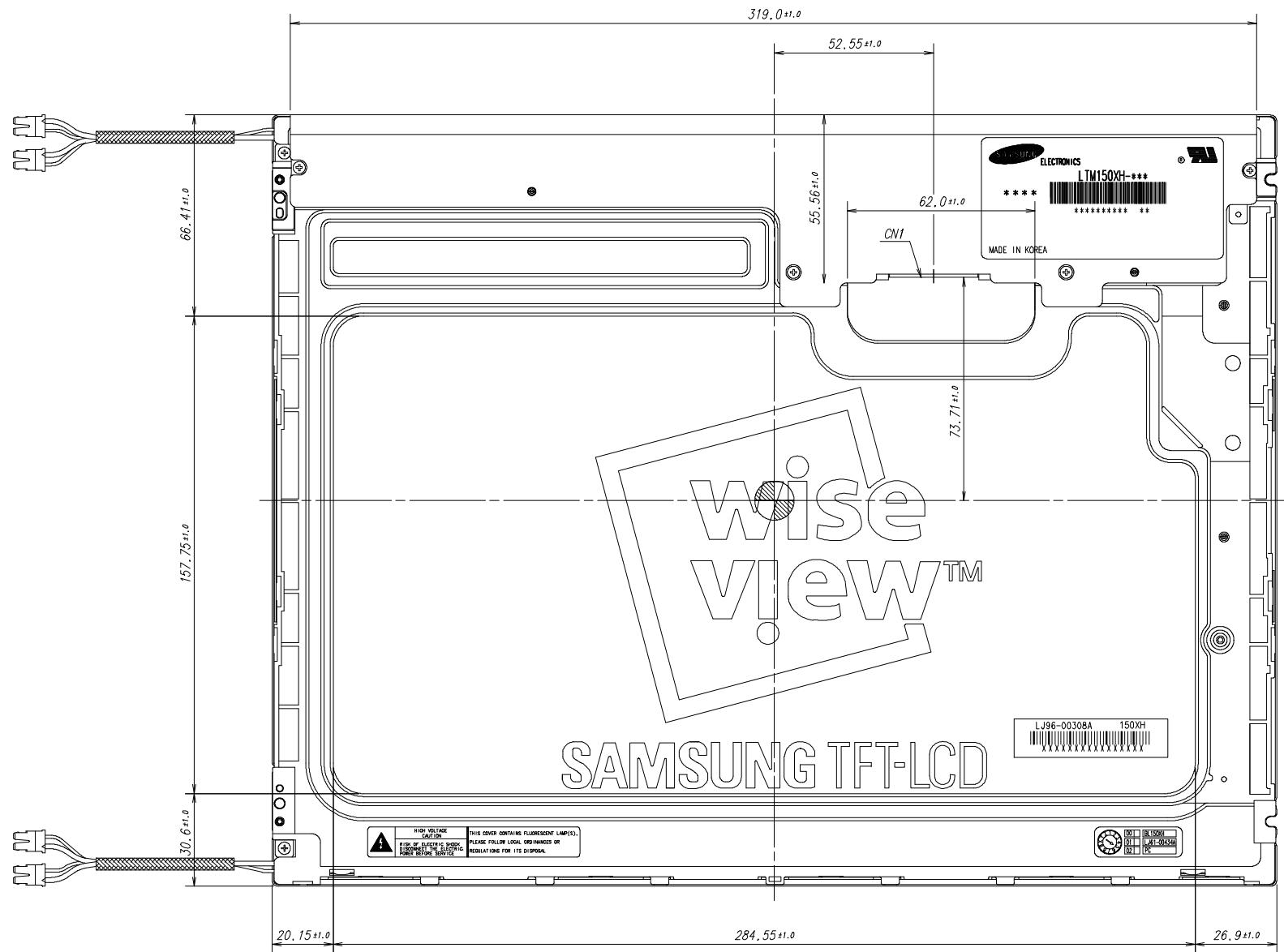
PRELIMINARY

NOTE

1. UNSPECIFIED TOLERANCE TO ± 0.5
2. WARP AND FLATING FOR
PCB AND CHASSIS ARE EXCLUDED FROM
THICKNESS AND DIMENSION OF THE UNIT.
3. CN2 : COFT CONNECTOR SPECIFICATION
- MAKER : YEON HO (or JST)
- PART NO : 35001HS (or BHSR-02VS-1)
- PIN LAYOUT

1	HOT
2	GND
4. TMDS INPUT CONNECTOR SPECIFICATION
-MAKER: HIROSE
-CNI: DF14H-20P-1.25H
5. TORQUE SPEC : 3.5 kgf.cm

* OUT LINE #.2 ; Rear View



8. GENERAL PRECAUTIONS

8.1 Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (h) Protect the module from static , it may cause damage to the CMOS Gate Array IC.
- (i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Pins of I/F connector shall not be touched directly with bare hands.

8.2 Storage

- (a) Do not leave the module in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

8.3 Operation

- (a) Do not connect, disconnect the module in the “Power On” condition.
- (b) Power supply should always be turned on/off by the item 6.5 “Power on/off sequence”.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly. The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

8.4 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on)
Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.